CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Akshay Attaluri

Project Number

J0802

Project Title

Tsunami Guard: Finding the Most Effective Wave Breaker Design

Abstract

Objectives/Goals

Coastal cities are constantly at risk from waves that can cause serious damage to structures. The aim of this project is to find the optimal wave breaker design that will ensure that these cities are no longer under a threat from waves. This is done by testing various designs of wave breakers using a simulation software that I designed, to see which is the most effective at reducing potential damage. I will evaluate the success of the barrier design by calculating the ratio of the energy transferred into the barrier to the amount of stress on the barrier. My goal is that this ratio for a certain barrier should be at least 10% higher than this ratio for the control, which is a plain wall.

Methods/Materials

I wrote my simulation in Python using the libraries "matplotlib", "pandas", "numpy", "math", and "random". I am also using the "tkinter" library to display the simulation in a GUI. The simulation is essentially a 3d graph with a particle at each point on the graph. This particle is either air, water, or is part of the barrier. As the simulation progresses, these water particles move towards the barrier in a wave, thus simulating a wave hitting a barrier.

Results

Of all the anchored designs, the "ditch" design has proven to be the most effective at reducing potential damage caused by waves. Even though it didn#t absorb as much energy from the wave as the control, it was under less stress, meaning that it would last for a longer time than the wall. When comparing the anchored grid and the floating grid designs, the floating design performed very well compared to the anchored design. The floating grid design was the only design that met the objective design criteria.

Conclusions/Discussion

According to the results, only the floating barrier met the engineering goal. This is due to the fact that the floating design is less susceptible to stress, as it has no defined axis of rotation, and therefore is subjected to a reduced amount of torque, leading to less stress. This shows that floating designs will last longer than anchored designs, and can be made using less durable and less expensive material that may or may not be buoyant. The only requirement is that it must not be fixed or anchored to the ground. My work suggests that fast, simple, and accurate models can be made to model complicated hydrodynamic simulations. This allows for faster research and development, which could save time, money, and lives.

Summary Statement

Using a simulation that I designed, I evaluated the effectiveness of different wave breaker designs and found the one that is the best at reducing potential damage.

Help Received

I designed and programmed the simulation software on my own after educating myself on the physics concepts using various websites.